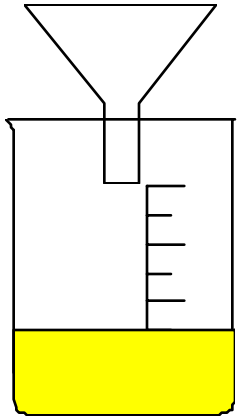
WATER FILTRATION IN KARST AREA

Objectives:

Students will:

- investigate to what extent water is filtered through different rock types,
- define porosity and permeability,
- examine how caves and sinkholes direct water flow,
- analyze why groundwater in karst areas is at greater risk of contamination
- identify several sources of pollution.



Materials:

- 2 2-liter clear plastic soda bottles with bottoms cut off
- 3 squares of flexible nylon screening (~ 3 inches of screening from a screen door would work, so would cheesecloth)
- 2 rubber bands
- A small piece of cheesecloth or pantyhose
- Large pebbles (about 4 cups)
- Small pebbles (about 4 cups)
- Coarse sand (about 4 cups)
- 2 large, graduated beakers (500 ml)
- 1 4-inch piece of 1-inch diameter flexible plastic tubing (a piece of garden hose)
- 1 small funnel (3 inch diameter, with stem that fits into tubing)
- Rain cans (tin cans with holes in the bottom)
- ½ cup vegetable oil
- ½ cup coffee grounds
- Red food coloring
- Pitchers or other containers to mix "contaminated water" (preferably clear)
- Photographs of sinkhole plains and polluted sinkholes

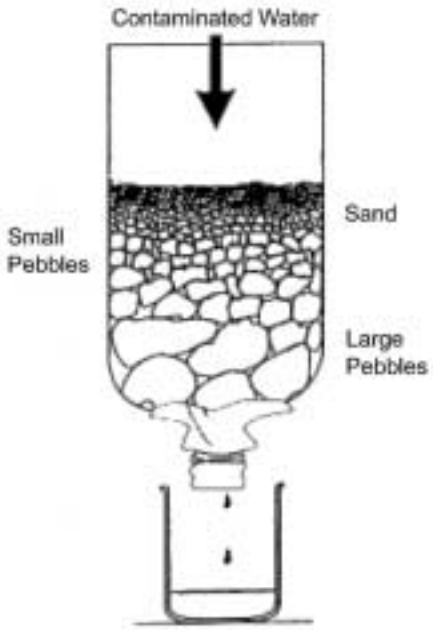
Procedure:

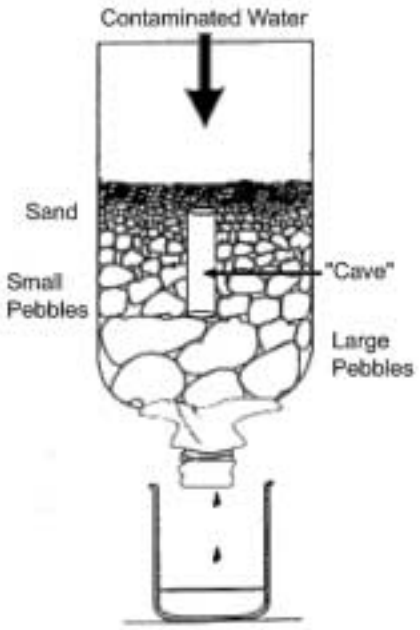
To keep the cave location a secret, steps 1-4 should be completed without student involvement.

1. With a rubber band, secure a piece of nylon screening (cheesecloth will work) over the mouth of each 2-liter bottle.
2. Set the bottles, inverted, in the empty beakers or jars. Label them "#1" and "#2."
3. Fill each bottle with identical rock layers. Start with large pebbles, then add a layer of small pebbles. In one bottle, bury tubing in the layer of small pebbles (see figure). Cover the top opening of the tubing with a square of nylon screening or pantyhose (tie a string onto the rubber band holding the square for easy removal later – hide the string.). This becomes the secret cave. Finish with a thin layer of sand.
4. Mix three different "pollutant" types and label the containers:
   - ½ cup vegetable oil with 6 cups of water ("Oil")
   - ½ cup coffee with 6 cups of water ("Sewage")

- several drops of food coloring with 6 cups of water ("Pesticides/Herbicides")

5. During class discuss the "rock types" or layers in the bottles. Which type is the most porous? Permeable? Tell them that the rocks represent limestone and sandstone. The limestone is very permeable and cracked. Sandstone is very porous. Ask students how porosity and permeability may affect filtration. If porosity and permeability are new concepts, write the definitions on the board.
6. Tell students that one bottle contains a cave, while the other does not. Ask them which rock layer most likely contains the cave. Review the definition of karst. Have students predict if one bottle will act as a better filter.
7. Show the containers of contaminated water. Discuss how water can become polluted.
   - What happens when rain falls on a parking lot?
   - Where does the oil go? Discuss how water can become brown and cloudy.
   - What does the water look like that runs off of a cow pasture?
   - What if a septic tank leaked?
   - Where would the sewage go?
   - What happens when it rains soon after pesticides are applied? Remember, not all pesticides contaminate the water. (For questions on this topic, consult your county extension agent.)
8. Have two volunteers assist you. Give each student 2 cups of the coffee water in the rain cans. Have each student hold their water over the bottles as it slowly sinks in and time the drainage. When water stops dripping into the beakers, show them to the class. Which bottle acted as a better filter? Which beaker contains more water? If one or both beakers contain less than 2 cups of water, where did the rest go? Were the results different for the two bottles? Have students record the results on the attached worksheet.
9. Pour out the beakers. Repeat step 8 using oily water, then red water.
10. Ask students which bottle contains a cave. How do they know?
11. Remove the nylon screen from the tubing. Fit the small funnel into the tubing and tell the class that the funnel represents a sinkhole. Define sinkholes. Show the class the pictures of sinkhole plains. Cover the funnel with the nylon screen and a thin layer of sand.





12. Have a student pour 2 cups of coffee water into the "karst" bottle. Discuss the results. Repeat with the oily and red water. Discuss how water is filtered as it passes through rock.
    - How well is water filtered in karst areas?
    - Would pollution be of greater concern in a karst area, or a non-karst area?
    - Were the pesticides filtered out in either bottle?
    - Show students the picture(s) of polluted sinkholes. Why might it be a bad idea to throw trash into sinkholes?

WATER FILTRATION WORKSHEET

NAME: _____ DATE:_____

SAMPLE	**APPEARANCE OF WATER**	**AMOUNT OF WATER**	**TIME**
BOTTLE 1 Water with 'Sewage' Contaminant			
BOTTLE 2 Water with 'Sewage' Contaminant			
BOTTLE 1 Water with 'Oil' Contaminant			
BOTTLE 2 Water with 'Oil' Contaminant			
BOTTLE 1 Water with 'Pesticide' Contaminant			
BOTTLE 2 Water with 'Pesticide' Contaminant			
BOTTLE WITH SINKHOLE Water with 'Sewage' Contaminant			
BOTTLE WITH SINKHOLE Water with 'Oil' Contaminant			
BOTTLE WITH SINKHOLE Water with 'Pesticide' Contaminant			

Discussion Questions:

1. Which bottle contained the cave? (#1 or #2?)

2. Which bottle filtered the contaminants the best? Why?

3. Which contaminant was most difficult to filter out? Why?

4. What are some examples of other pollutants that could affect groundwater?

5. Why is clean groundwater important?

6. Define: Karst, Sinkhole, Porosity, Permeability. How does each affect underground water flow and filtration?